

WHAT IS CLAIMED IS:

1. A data processing system comprising:
  - a first storage system that is connected to a host device and sends and receives data to and from the host device;
  - 5 a second storage system that is connected to the first storage system and receives data from the first storage system; and
  - a third storage system that is connected to the first storage system and receives data from the first storage system, wherein
    - the first storage system includes a first storage area that stores
    - 10 data sent from the host device, and a second storage area that stores the data written in the first storage area and update information relating to the data written in the first storage area,
    - the second storage system includes a third storage area that stores data sent from the first storage system, and a fourth storage area that
    - 15 stores the data written in the third storage area and update information relating to the data written in the third storage area, and
    - the third storage system includes a fifth storage area that stores data read from the second storage area and update information relating to the data read from the second storage area, and a sixth storage area that
    - 20 stores data that is generated based on the data written in the fifth storage area and the update information relating to the data written in the fifth storage area.

2. A data processing system according to claim 1, wherein data writing in the first storage area in the first storage system is performed synchronously with data writing in the third storage area in the second storage system.

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3. A data processing system according to claim 2, wherein the first storage system requests, upon receiving from the host device a data write request to write data, the second storage system to write the data therein, and notifies, after receiving a write response from the second storage system, the host device of a completion of the data write request, wherein the first storage system writes in the first storage area the data sent from the host device, and writes in the second storage area the data written in the first storage area and update information relating to the data written in the first storage area.

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4. A data processing system according to claim 3, wherein the first storage system generates, upon receiving from the host device the data write request, an update number that is used for identifying a data update order, and includes the update number in the data write request that is sent to the second storage system, wherein the update information written in the second storage area includes the update number.

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5. A data processing system according to claim 3, wherein the second storage system sends, upon receiving from the first storage system

the data write request, the write response to the first storage system,  
writes in the third storage area the data sent from the first storage system,  
and writes in the fourth storage area the data written in the third storage  
area and update information relating to the data written in the third  
5 storage area.

6. A data processing system according to claim 5, wherein the  
second storage system obtains an update number that is included in the  
data write request sent from the first storage system to be used for  
10 identifying a data update order, wherein the update information written  
in the fourth storage area includes the update number obtained by the  
second storage system.

7. A data processing system according to claim 1, wherein data  
15 writing in the first storage area in the first storage system is performed  
asynchronously with data writing in the sixth storage area in the third  
storage system.

8. A data processing system according to claim 7, wherein  
20 the first storage system sends to the third storage system the data  
and the update information relating to the data written in the second  
storage area, and

the third storage system writes in the fifth storage area the data  
and the update information relating thereto sent from the first storage

system, and writes in the sixth storage area data generated based on the data and the update information relating thereto written in the fifth storage area.

5           9.     A data processing system according to claim 8, wherein the third storage system controls to read at specified time intervals from the first storage system the data and the update information relating thereto written in the second storage area in the first storage system.

10           10.    A data processing system according to claim 8, wherein the first storage system generates, upon receiving a data write request from the host device, an update number that is used for identifying a data update order, wherein the update information written in the second storage area in the first storage system includes the update number  
15   generated by the first storage system.

          11.    A data processing system according to claim 8, wherein the update information written in the fifth storage area in the third storage system includes an update number that is used for identifying a data  
20   order number.

          12.    A data processing system according to claim 1, wherein the first storage system includes a plurality of the first storage areas, wherein

the update information written in the second storage area is created for data that is written in the plurality of the first storage areas.

13. A data processing system according to claim 1, wherein the  
5 second storage system includes a plurality of the third storage areas,  
wherein the update information written in the fourth storage area is  
created for data that is written in the plurality of the third storage areas.

14. A data processing system according to claim 1, wherein the  
10 third storage system includes a plurality of the sixth storage areas,  
wherein data that is written in the plurality of the sixth storage areas is  
generated based on data and update information relating to the data  
written in the fifth storage area.

15. A data processing system according to claim 1, wherein  
15 the update information written in the second storage area in the  
first storage system includes an update number that is generated by the  
first storage system to be used for identifying a data update order,  
the update information written in the fourth storage area in the  
20 second storage system includes the update number included in the update  
information written in the second storage area, and  
the update information written in the fifth storage area in the third  
storage system includes the update number included in the update  
information written in the second storage area.

16. A data processing system comprising:

a first storage system that is connected to a first host device and sends and receives data to and from the first host device;

5 a second storage system that is connected to a second host device and the first storage system and receives data from the first storage system; and

a third storage system that is connected to the first storage system and receives data from the first storage system, wherein

10 the first storage system includes a first storage area that stores data sent from the first host device, and a second storage area that stores the data written in the first storage area and update information relating to the data written in the first storage area,

the second storage system includes a third storage area that stores  
15 data sent from the first storage system, and a fourth storage area that stores the data written in the third storage area and update information relating to the data written in the third storage area, and

the third storage system includes a fifth storage area that stores data read from the second storage area and update information relating to  
20 the data read from the second storage area, and a sixth storage area that stores data that is generated based on the data written in the fifth storage area and the update information relating to the data written in the fifth storage area.

17. A data processing system according to claim 16, wherein  
the update information written in the second storage area in the  
first storage system includes an update number that is generated by the  
first storage system to be used for identifying a data update order,

5 the data update information written in the fourth storage area in  
the second storage system includes the update number included in the  
data update information written in the second storage area, and  
the data update information written in the fifth storage area in the  
third storage system includes the update number included in the data  
10 update information written in the second storage area.

18. A data processing system according to claim 17, wherein,  
when the first storage system fails,

the third storage system sends to the second storage system latest  
15 update information relating to the update information written in the fifth  
storage area, and

the second storage system judges, based on the latest update  
information sent from the third storage system and by using data written  
in the fourth storage area, as to whether data update for the fifth storage  
20 area in the third storage system is possible.

19. A data processing system according to claim 18, wherein,  
when the second storage system judges by using the data written in the

fourth storage area that data update for the fifth storage area in the third storage system is possible,

the third storage system determines data that is not written in the fifth storage area and update information relating thereto based on the  
5 data and the update information relating thereto written in the fourth storage area in the second storage system.

20. A data processing system according to claim 18, wherein,  
when the second storage system judges by using the data written in the  
10 fourth storage area that data update for the fifth storage area in the third storage system is possible,

the third storage system controls to read from the second storage system data that is not written in the fifth storage area and update information relating thereto among the data and the update information  
15 relating thereto written in the fourth storage area in the second storage system.

21. A data processing system according to claim 20, wherein the second storage system writes in the third storage area data sent from the  
20 second host device, and writes in the fourth storage area the data written in the third storage area and update information relating to the data written in the third storage area.



22. A data processing system according to claim 21, wherein data writing in the third storage area in the second storage system is performed asynchronously with data writing in the sixth storage area in the third storage system.

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23. A data processing system according to claim 22, wherein the second storage system sends to the third storage system the data written in the fourth storage area and the update information relating to the data written in the fourth storage area, and

10 the third storage system writes in the fifth storage area the data and the update information relating thereto sent from the second storage system, and writes in the sixth storage area data generated based on the data and the update information relating thereto written in the fifth storage area.

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24. A data processing system according to claim 23, wherein the third storage system controls to read at specified time intervals from the second storage system the data and the update information relating thereto written in the fourth storage area in the second storage system.

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25. A data processing system according to claim 23, wherein the second storage system generates, upon receiving from the second host device a data write request, an update number that is used for identifying a data update order, wherein the update information written in the fourth

storage area in the second storage system includes the update number generated by the second storage system.

26. A data processing system according to claim 23, wherein the  
5 update information written in the fifth storage area in the third storage system includes an update number that is used for identifying a data update order.

27. A data processing system according to claim 23, wherein the  
10 update information written in the fourth storage area in the second storage system after the first storage system fails includes an update number that is generated by the second storage system to be used for identifying a data update order, wherein the update information written in the fifth storage area in the third storage system includes the update  
15 number generated by the second storage system.

28. A data processing system according to claim 17, wherein,  
when the first storage system fails,  
the third storage system sends to the second storage system latest  
20 update information relating to the update information written in the fifth storage area, and  
the second storage system judges, based on the latest update information sent from the third storage system and by using data written

in the third storage area, as to whether data update for the fifth storage area in the third storage system is required.

29. A data processing system according to claim 16, wherein,
- 5 when the first storage system fails,
- the second storage system controls to stop wiring data sent from the first storage system in the third storage area, and to write data sent from the second host device in the third storage area, and
- the first storage system controls to stop wiring data sent from the
- 10 first host device in the first storage area, and to write data sent from the second storage system in the first storage system.

30. A data processing system according to claim 29, wherein
- the first storage system writes in the second storage area data
- 15 written in the first storage area and update information relating to the data written in the first storage area,
- the second storage system writes in the fourth storage area data written in the third storage area and update information relating to the data written in the third storage area, and
- 20 the third storage system stops reading data and update information relating to the data from the second storage area in the first storage system, reads data and update information relating to the data from the fourth storage area in the second storage system and writes the data and the update information read from the fourth storage area, and writes data

generated based on the data and the update information relating to the data written in the fifth storage area.

31. A data processing system according to claim 30, wherein  
5 the update information written in the fourth storage area in the second storage system includes an update number that is generated by the second storage system to be used for identifying a data update order,

the update information written in the second storage area in the first storage system includes the update number generated by the second  
10 storage system, and

the update information written in the fifth storage area in the third storage system includes the update number generated by the second storage system.

15 32. A data processing system according to claim 30, wherein data writing in the third storage area in the second storage system is performed synchronously with data writing in the second storage area in the first storage system.

20 33. A data processing system according to claim 32, wherein the second storage system requests, upon receiving from the second host device a data write request to write data, the first storage system to write the data therein, and notifies, after receiving a write response from the

first storage system, the second host device of a completion of the data write request.

34. A data processing system according to claim 33, wherein the  
5 second storage system generates, upon receiving from the second host device the data write request, an update number that is used for identifying a data update order, and includes the update number in the data write request that is sent to the first storage system, wherein the update information written in the fourth storage area includes the update  
10 number generated by the second storage system.

35. A data processing system according to claim 35, wherein the first storage system sends, upon receiving the data write request from the second storage system, the write response to the second storage system,  
15 and obtains an update number that is included in the data write request sent from the second storage system to be used for identifying a data update order, wherein the update information written in the second storage area includes the update number obtained by the first storage system.

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36. A data processing system according to claim 30, wherein data writing in the third storage area in the second storage system is performed asynchronously with data writing in the sixth storage area in the third storage system.

37. A data processing system according to claim 36, wherein  
the second storage system sends to the third storage system the  
data and the update information relating to the data written in the fourth  
5 storage area, and  
the third storage system writes in the fifth storage area the data  
and the update information relating thereto sent from the second storage  
system, and writes in the sixth storage area data generated based on the  
data and the update information relating thereto written in the fifth  
10 storage area.

38. A data processing system according to claim 37, wherein the  
third storage system controls to read at specified time intervals from the  
second storage system the data and the update information relating  
15 thereto written in the fourth storage area in the second storage system.

39. A data processing system according to claim 37, wherein the  
second storage system generates, upon receiving a data write request from  
the second host device, an update number that is used for identifying a  
20 data update order, wherein the update information written in the fourth  
storage area in the second storage system includes the update number  
generated by the second storage system.

40. A data processing system according to claim 37, wherein the update information written in the fifth storage area in the third storage system includes the update number generated by the second storage system.